

Segment 1

The tree house detectives are concerned about Jacob. He is becoming obsessed with staying well because he is afraid that an illness will prevent him from going on his vacation to Fort Jefferson in the Dry Tortugas. After hearing about a possible flu epidemic, Jacob becomes convinced that he must quarantine himself. The other tree house detectives are not sure this is the smart thing to do, so they decide to help him investigate disease and how it spreads. Dr. Consuelo Beck-Sague, a medical epidemiologist at the Centers for Disease Control (CDC) in Atlanta, Georgia helps the detectives learn more about viruses and bacteria while learning how infectious disease spreads. Now Jacob is even more adamant that quarantine is the right way to go and visits Christina Stevens at NASA Johnson Space Center in Houston, Texas to learn more about NASA's Health Stabilization Program used to keep astronauts healthy before, during, and after space flight.

Objectives

The students will

- understand the conditions necessary for microbe growth.
- learn how minor variations account for various outcomes in an experiment.
- describe the differences between viruses and bacteria.
- identify how infectious disease is transferred from person to person.
- identify ways to avoid infectious disease.
- learn about quarantines.
- conduct an experiment in which a control is necessary to interpret results.

Vocabulary

agar– a jellylike substance obtained from a red alga and used especially in culture media or to give firmness to foods

antibiotic– a substance produced by an organism (as a fungus or bacterium) that in a diluted solution inhibits or kills a harmful microscopic plant or animal, and especially one that causes disease

bacteria– plural form of bacterium

bacterium– any of a group of single-celled microorganisms that live in soil, water, organic matter, or the bodies of plants and animals and are important because of their chemical effects and as a cause of disease

cell– one of the tiny units that are the basic building blocks of living things, that carry on the basic functions of life either alone or in groups, and that include a nucleus and are surrounded by a membrane

DNA– deoxyribonucleic acid; any of various nucleic acids are usually the molecular basis for heredity

epidemiology– a branch of medical science that deals with the occurrence, distribution, and control of disease in a population

disease– an abnormal bodily condition of a living plant or animal that interferes with functioning and can usually be recognized by signs and symptoms; an illness

microorganism– an organism (as a bacterium) of microscopic or less than microscopic size

quarantine– a limiting or forbidding of movements of persons or goods that is designed to prevent the spread of disease or pests

RNA– any of various nucleic acids that contain ribose and uracil as structural components and are associated with control of cellular chemical activities

virus– any of a large group of very tiny infectious agents that are too small to be seen with the ordinary light microscope but can often be seen with the electron microscope, that are considered either very simple microorganisms or very complicated molecules, that have an outside coat of protein around a core of RNA or DNA, that can grow and multiply only in living cells, and that cause important diseases in human beings, lower animals, and plants

Video Component

Implementation Strategy

The NASA SCI Files™ is designed to enhance and enrich the existing curriculum. Two to three days of class time are suggested for each segment to fully use video, resources, activities, and web site.

Before Viewing

1. Prior to viewing Segment 1 of *The Case of the Biological Biosphere*, read the program overview (p. 5) to the students. List and discuss questions and preconceptions that students may have about quarantine, disease, bacteria, and viruses.
2. Record a list of issues and questions that the students want answered in the program. Determine why it is important to define the problem before beginning. From this list, guide students to create a class or team list of three issues and four questions that will help them to better understand the problem. The following tools are available in the educator area under the "Tools" section of the web site to assist in the process.

Careers

epidemiologist
biologist
clinician
public health worker

Problem Log—Printable student log with the stages of the problem-solving process

Brainstorming Map—Graphic representation of key concepts and their relationships

The Scientific Method—Chart that describes the scientific method process

3. **Focus Questions**—Questions at the beginning of each segment that help students focus on a reason for viewing. These can be printed ahead of time from the educator's area of the web site in the activities and worksheet section under "Worksheets." Students should copy these into their science journals prior to viewing the program. Encourage students to take notes while viewing the program to answer the questions. An icon will appear when the answer is near.

4. **What's Up? Questions**—Questions at the end of the segment help students predict what actions the tree house detectives should take next in the investigation process and how the information

learned will affect the case. These questions can be printed from the educator's area of the web site in the activities and worksheet section under "Worksheets."

View Segment 1 of the Video

For optimal educational benefit, view *The Case of the Biological Biosphere* in 15-minute segments and not in its entirety. If you are viewing a taped copy of the program, you may want to stop the video when the Focus Question icon appears to allow students time to answer the question.

After Viewing

1. Have students reflect on the "What's Up?" questions asked at the end of the segment.
2. Discuss the Focus Questions.
3. Students should work in groups or as a class to discuss and list what they know about quarantine, disease, bacteria, and viruses. Have the students brainstorm ideas on how Jacob can avoid infectious disease. Discuss what Jacob should do to have the most effective quarantine. As a class, reach a consensus on what additional information is needed. Have the students conduct independent research or provide students with the information needed.
4. Have the students complete Action Plans, which can be printed from the "Problem Board" area in the "Problem-Solving Tools" section of the web site for the current online investigation. Students should then conduct independent or group research by using books and internet sites noted in the "Research Rack" section of the "Problem Board" area. Educators can also search for resources by topic, episode, and media type under the Educator's main menu option Resources.
5. Choose activities from the educator guide and web site to reinforce concepts discussed in the segment. The variety of activities is designed to enrich and enhance your curriculum. Activities may also be used to help students "solve" the problem along with the tree house detectives.
6. Have the students work individually, in pairs, or in small groups on the Problem-Based Learning (PBL) activity on the NASA SCI Files™ web site.
 - To begin the PBL activity, read the scenario to the students.



- Read and discuss the various roles involved in the investigation.
 - Print the criteria for the investigation and distribute.
 - Have students use the "Research Rack" located on the web site and the online tools that are available.
7. Having students reflect in their journals what they have learned from this segment and from their own experimentation and research is one way to assess the students. In the beginning, students may have difficulty reflecting. To help students, give them specific questions to reflect upon that are related to the concepts.
 8. Have students complete a Reflection Journal, which can be found in the Problem-Solving Tools section of the online PBL investigation or in the Instructional Tools section of the Educator's area.
 9. The NASA SCI Files™ web site provides educators with general and specific evaluation tools for cooperative learning, scientific investigation, and the problem-solving process.

Resources (additional resources located on web site)

Books

Baeuerle, Patrick A., Norbert Landa, and Patrick Bauerle: *The Cell Works: Microexplorers: An Expedition into the Fantastic World of Cells (Microexplorers Series)*. Barrons Juveniles, 1998, ISBN: 0764150529.

Berger, Melvin: *Germs Make Me Sick! (Let's-Read-And-Find-Out Science, Stage 2)*. Scott Foresman, 1995, ISBN: 0064451542.

Krulik, Nancy E.: *The Magic School Bus in a Pickle: A Book About Microbes (Magic School Bus Book Series)*. Scholastic Trade, 1998, ISBN: 0590393774.

Robbins, Louise: *Louis Pasteur and the Hidden World of Microbes (Oxford Portraits in Science)*. Oxford University Press, 2001, ISBN: 0195122275.

VanCleave, Janice: *Janice VanCleave's Biology For Every Kid : 101 Easy Experiments That Really Work*. John Wiley, 1990, ISBN: 0471503819.

Wenkman, Leeann: *Body Buddies Say... "Wash Your Hands!"* Sunrise Publications, 1999, ISBN: 0967079004.

Centers for Disease Control (CDC)

The Centers for Disease Control and Prevention (CDC) is recognized as the lead federal agency for protecting the health and safety of people. Explore the CDC's web site to learn what is new in disease and the prevention of illness. Body and Mind (BAM) Kids page has activities and a teacher corner.
<http://www.cdc.gov/>

Boston Museum of Science: Scanning Electron

Look at actual images from an electron microscope, visit some cool links, and in the teacher corner, learn how to build a microscope and make slides.
<http://www.mos.org/sln/SEM/index.html>

Microbial Zoo

Learn about microbes and microbial ecology.
<http://commtechlab.msu.edu/sites/dlc-me/zoo/>

How to make a \$1.00 compound microscope

Visit this web site to learn how to build your own microscope from common objects.
http://www.funsci.com/fun3_en/ucomp1/ucomp1.html

NASA Johnson Space Center: Medical Operations Branch Mission Support

Visit this web site to learn more about the programs in place to maintain astronauts' health and safety.
<http://www.jsc.nasa.gov/sa/sd/sd2/missup.html>

Web Sites



Activities and Worksheets

In the Guide

Growing Cold

Conduct this experiment to learn how temperature affects the growth of microbes.18

Chaotic Chaos

Perform this experiment to learn that you can't always predict the outcome even when you think you can.19

Virus Versus Bacteria

Compare and contrast viruses and bacteria.20

Stop in the Name of Infection

Simulate how infection is spread.23

Answer Key

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On the Web

Coconuts for You

This "nutty" experiment helps to explain where microbes grow best.

Stop that Germ!

Brainstorm ideas on how to prevent the spread of infectious diseases.

This is Control

Conduct this experiment to learn why a control is necessary.

Growing Cold

Purpose

To learn how temperature affects the growth of bacteria

Procedure

1. Measure 250 ml of milk and pour into one of the pint jars.
2. Close the jar by replacing the lid.
3. Repeat with the second jar.
4. Place one jar in the refrigerator.
5. Place the second jar in a warm place.
6. Observe each jar once a day for seven days and record your observations.

Materials

500 ml of fresh milk
measuring cup
2 pint (500 ml) jars
refrigerator
science journal

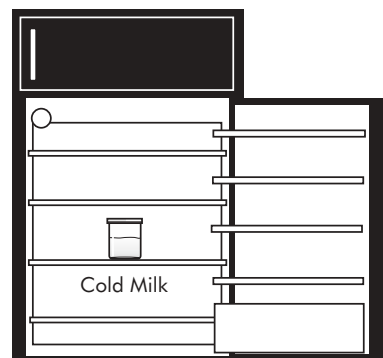


Warm Milk



Diagram 1

Refrigerator



Refrigerator with milk inside.

Diagram 2

Conclusion

1. After seven days, describe the difference between the cold milk and the warm milk.
2. Why was the warm milk different from the cold milk?
3. How could the tree house detectives use this information to help Jacob stay well?

Chaotic Chaos

Purpose

To demonstrate that small variations can cause large differences

Procedure

1. Make a ball of clay and secure the plastic ball inside the large container with the clay. See diagram 1.
2. Use the permanent marker and mark a dot in the middle on the top of the ball.
3. Fill the pitcher with water.
4. Predict the path of the water flow.
5. Pour a small amount of water on top of the dot and observe how the water runs down the ball and into the container.
6. Record your observations in your science journal.
7. Dry the ball if necessary and repeat steps 4-6 several more times.

Materials

large container
pitcher
water
small smooth plastic
or rubber ball
permanent marker
clay
science journal

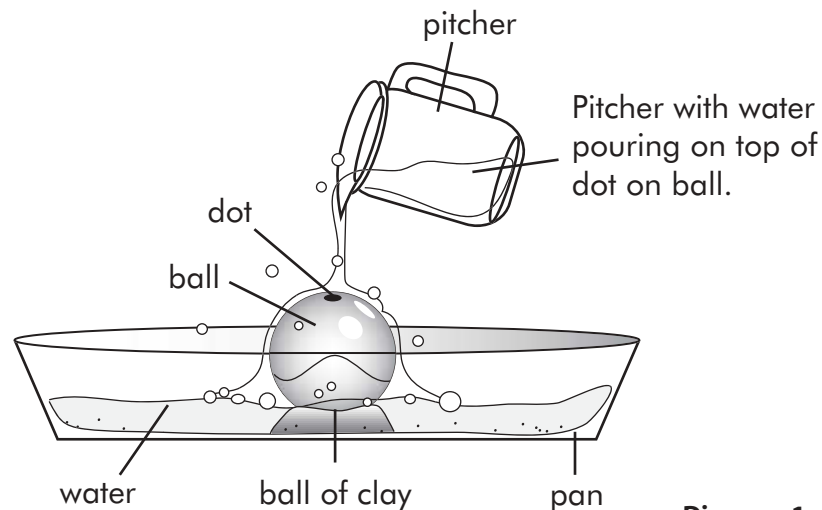


Diagram 1

Conclusion

1. Did the water run the exactly the same way each time? Why or why not?
2. What are some possible variables that caused differences?
3. How can this experiment be used to help Jacob?

Virus Versus Bacteria

Purpose

To learn how viruses differ from bacteria

Procedure

1. Read the paragraph below.
2. In your group, compare and contrast viruses and bacteria and record results in your science journal.
3. Separate the description cards by cutting along the dotted lines.
4. Study the Venn diagram and note that one circle is labeled "Virus" and the other is labeled "Bacteria." Observe that the two circles overlap.
5. Place the description cards that describe only viruses in the circle labeled "Virus."
6. Place the description cards that describe only bacteria in the circle labeled "Bacteria."
7. Place the description cards that describe both viruses and bacteria in the overlap portion of the Venn diagram.
8. Once your group agrees on all placements, tape each card to the Venn diagram.
9. Using books, the Internet, or other resources, research viruses and bacteria and make a list of any new traits that you find.
10. Create new description cards and place on the Venn diagram.
11. Share your Venn diagram with the class and discuss.
12. Use construction paper to draw a diagram of a bacterium and a virus and label.

Materials

Venn diagram sheet
description cards
scissors
tape
science journal

Conclusion

1. How were bacteria similar to viruses?
2. How were they different?
3. Should Jacob be more cautious and stay away from viruses or bacteria? Why?

Viruses and Bacteria:

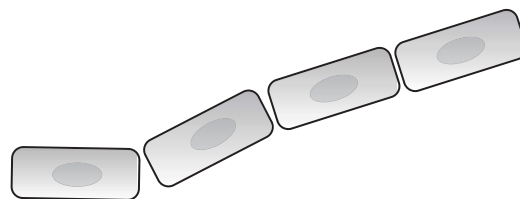
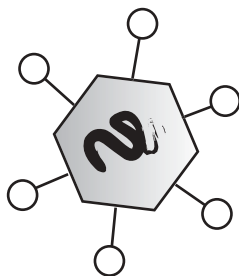
A virus is an organism that is so tiny that it can only be seen with an electron microscope. Viruses are much smaller than bacteria and can cause many diseases in man, plants, and animals. A virus is not a plant or an animal but a special kind of parasite. They consist of nucleic acids with a coat of protein. Unlike bacteria, viruses are not composed of cells but they do reproduce. A virus contains only DNA or RNA but never both. Viral infections are a concern to the human body because the body often does not have any natural defenses in place to fight the virus. However once the virus enters the body, the body adapts to the condition by generating new defenses (antibodies). Antibodies may be artificially created in the body by vaccines. Scientists have discovered that viruses cause chicken pox, rabies, mumps, polio, measles, yellow fever, and even the common cold. Good hygiene habits are important in preventing viral infections.

Bacteria are tiny one-celled organisms that can be seen with a light microscope. Bacteria are found everywhere and most bacteria are good. For example, bacteria in the soil cause dead animals and plants to decay and make the soil rich for new plants. However, if bacteria not normally found in the human body enter the body, they will begin to multiply rapidly and cause an illness. Bacteria have both RNA and DNA located in the cell. Some bacteria such as E. coli are found naturally in certain parts of the body, but if they move to another part, they will cause illness also. Strep throat and bacterial pneumonia are two types of bacterial infection. Most bacterial infections are fought off by the body's own defenses, but some may overwhelm the defense network. Luckily, most can be cured with drugs known as antibiotics.

Virus Versus Bacteria (continued)

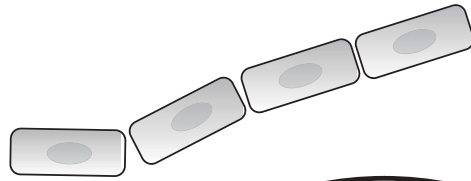
Description Cards

Has a protein coat	Not composed of cells	Can reproduce	Mumps and measles are types of these
One-celled organisms	Vaccines protect you from these	E. coli is a type of these	Antibiotics help kill these
Most are good	Has only DNA or RNA	Has both DNA and RNA	Antibodies are a natural defense for these
Makes you sick	Most are bad	Can be seen with an electron microscope	Can be seen with a light microscope

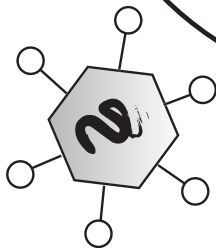


Virus Versus Bacteria Diagram

Virus vs. Bacteria



Bacteria



Virus

Stop in the Name of Infection

Purpose: To simulate how infection can be spread

Teacher Note Be sure to check with students and parents to find out if any have allergies to hand lotion.

Procedure

1. Put a small amount of hand lotion on your hands and rub them together, spreading the lotion on both the top and bottom of your hands.
2. Hold your hands over a large container and have your partner sprinkle a small amount of glitter into your hands.
3. Gently rub your hands together to spread the glitter evenly.
4. Use a paper towel to wipe the glitter off your hands.
5. Have your partner rinse his/her hands with cold water.
6. Both you and your partner wash your hands with warm water and soap.

Materials

list of prefixes and
suffixes
paper
pencil
colored pencils
construction paper

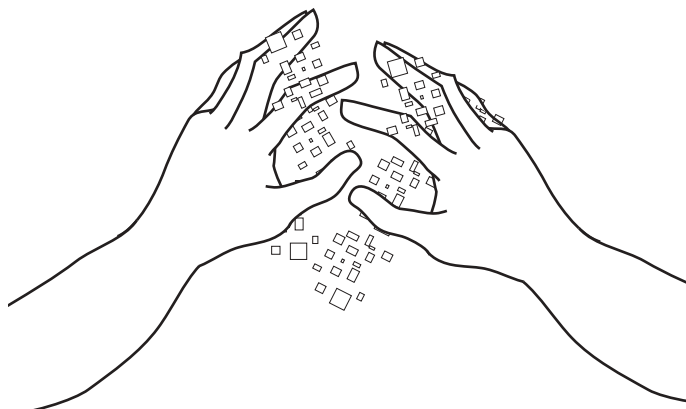


Diagram 1

Conclusion

1. The glitter represented germs (bacteria and/or viruses) that you can easily pick up by coming in contact with surfaces that they are on. Did cleaning your hands with just a paper towel do a good job of getting the "germs" off your hands? Why or why not?
2. What would happen if you came in contact with other people?
3. Did washing your hands with cold water get all the "germs" off your hands? How about the warm water and soap?
4. Why is it important to properly wash your hands frequently?
5. After conducting this experiment, what would you recommend to Jacob to help him stay healthy?

Answer Key

Growing Cold

1. The warm milk is thick and has white lumps in it. It also smells sour. The cold milk looks and smells much like it did when it was first placed in the refrigerator. It is also probably still drinkable.
2. The warm milk was exposed to warm temperatures that promote the growth of bacteria that can cause food to go bad and spoil. Cooler temperatures slow down the growth of the bacteria. However, eventually the milk in the refrigerator will spoil if it is left in there long enough. The bacteria are present in the milk and just grow very slowly when cold.
3. The tree house detectives could make sure that all the food Jacob eats has been properly refrigerated. They could also install an air conditioning system to keep the temperature cold in the tree house.

Chaotic Chaos

1. The water did not run exactly the same way each time. There were many variables that caused the water to run differently.
2. Some possible variables are scratches, grooves, or striations on the ball, the amount of water poured, the position of the water as it is poured (impossible to pour it exactly the same each time), and possible movement of the ball or vibration in the classroom.
3. This experiment should help Jacob see that it is impossible to control everything. No matter how hard he tries, he just can't control all the variables. Therefore, quarantine may not be the best answer. He needs to keep researching to find out more about staying healthy.

Viruses Versus Bacteria

1. Some ways that bacteria are similar to viruses are that they both reproduce, cause illness, and are too small to see with the naked eye.
2. Some ways that bacteria are different from viruses are that viruses are smaller than bacteria, are not composed of cells, and have only DNA or RNA, not both.
3. Jacob should be careful of viruses and bacteria as they both can cause illness.

Stop in the Name of Infection

1. Cleaning your hands with just a paper towel was not very effective in getting the "germs" off your hands. The glitter was stuck to your hands by the hand lotion.
2. Much of the glitter remained and could easily be passed on to other people you come in contact with.
3. Washing your hands in cold water was a little more effective, but a lot of glitter remained on your hands. Hand lotion may have an oil base to it, and the oil is difficult to remove with just cold water. Warm, soapy water was much more effective in getting rid of the "germs."
4. It is important to properly wash your hands frequently throughout the day to remove any bacteria or viruses that you may have come in contact with. Using common sense, you should know to wash your hands after going to the bathroom,

shaking someone's hand that is sick, or touching objects that a sick person has been in contact with.

5. Recommend that Jacob wash his hands frequently.

On the Web

Coconuts for You

1. Mold was growing on the inside of the coconut. The outside looked normal, with no mold visible.
2. Mold is a form of fungus, and the fungi came from the air. Fungi are all around you—in the air, on your clothes, skin, hands, and even your mouth.
3. Fungi cannot make their own food because they do not have chlorophyll, so they take food from a host organism. All fungi must have food, air, and water to live and when they land on a nice moist airy piece of food like the coconut, they multiply and grow very well.

Stop that Germ!

1. The glitter came off the block and onto everyone's hands. The same thing happened when the block was passed around the class, but now everyone has different colored glitter on their hands. Germs have been spread.
2. When you wiped the block with the paper towel some of the glitter came off but a lot of it stayed on the block. The soap and water took more of the glitter off the block than the paper towel.
3. Answers will vary but should include that washing your hands before you eat will help to keep germs from getting on the food that goes into your mouth and into your body. The fewer germs entering the body, the less likely a person is to get sick. Washing your hands after you use the restroom helps to keep the germs that are associated with your waste products from entering your body through your mouth (putting your hands in your mouth), eyes (rubbing your eyes), or nose (rubbing your nose). Washing with warm water and soap for 15 seconds is recommended.

This Is Control Calling

1. Answers will vary.
2. Answers will vary, but expect that if conditions were right, then the plant that received fertilizer grew better than the plant that did not. Fertilizer is a plant food and when added to the soil, it provides additional nutrients that help to enhance plant growth.
3. It is necessary to have a control for comparison. If you did not have a control plant, then you would not know how the plant would have grown normally without fertilizer; therefore, you would not have had anything to compare it to.
4. It was important to keep all the variables the same in each cup so that you would know that the fertilizer is what made the plants grow differently. Answers will vary.

